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EXAMINER

SAVLA, ARPAN P

ART UNIT

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/824,751	Applicant(s) DUSSUD, PATRICK H.	
	Examiner Arpan P. Savla	Art Unit 2185	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 January 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12, 14 and 17-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12, 14 and 17-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

This Office action is in response to Applicant's communication filed January 14, 2008 in response to the Office action dated April 10, 2007. Claims 1-12, 14, and 17-19 have been amended. Claims 13, 15, and 16 have been canceled. Claims 1-12, 14, and 17-24 are pending in this application.

OBJECTIONS

Claims

1. In view of Applicant's amendment, the objection to claim 19 has been withdrawn.

REJECTIONS NOT BASED ON PRIOR ART

Claim Rejections - 35 USC § 101

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. **Claims 1-11 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.** Claims 1-11 are not limited to tangible embodiments. In view of Applicant's disclosure, paragraphs 0023 and 0025, the computer readable medium is not limited to tangible embodiments, instead being defined as including both tangible embodiments (e.g. RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic

storage devices) and intangible embodiments (e.g. modulated data signal, such as a carrier wave or wireless media such as acoustic, RF, infrared and other wireless media, etc.). As such, claims 1-11 are not limited to statutory subject matter and are therefore non-statutory. It should be noted that wireless media such as acoustic, RF, infrared and other wireless media (i.e. transmission media) are "apparatuses" by definition. Therefore, each would be considered a computer readable medium apparatus. However, transmission media are still intangible embodiments, accordingly, the Examiner maintains the 101 rejections.

REJECTIONS BASED ON PRIOR ART

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. **Claims 1-12, 14, and 17-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grarup et al. (U.S. Patent 6,308,185) (hereinafter "Grarup") in view of Agesen et al. (U.S. Patent 6,529,919) (hereinafter "Agesen").**

6. **As per claim 1**, Grarup discloses a computer-readable medium apparatus having computer-executable instructions for performing ephemeral garbage collection, the computer readable medium being accessible by a computing device (col. 17, lines 31-61; Fig. 9), the instructions comprising:

each memory location corresponding to one of a plurality of cards associated with a card table, wherein the card table identifies one or more cards that have been accessed (col. 9, lines 19-25 and 37-57; Fig. 4b, element 450), each card being associated with one or more objects allocated from within a memory heap (col. 7, lines 58-60; Fig. 4a, element 408). *It should be noted that the "array of card marks" is analogous to the "card table."*

wherein each bundle identifies groupings of subsets of the plurality of cards (col. 8, lines 64-67; col. 11, lines 18-25; Fig. 4b, elements 408, 420, and 452; Fig. 5, element 512);

for each marked card, determining at least one accessed object within the marked card (col. 12, lines 51-54 and col. 12, line 66 – col. 13, line 1; Fig. 7a, elements 702 and 708); *It should be noted that "dirty" indicates "accessed."*

and performing garbage collection upon the at least one accessed object (col. 13, lines 1-4; Figs. 7b-7e).

Grarup does not disclose requesting a list from a tracking mechanism, the list identifying a plurality of memory locations that have been accessed since the last ephemeral garbage collection;

creating a bundle table identifying a plurality of bundles;

updating bundles by marking two or more of the plurality of bundles in the table using the list, wherein the updated marked bundle corresponds to marked cards in the marked bundle having associated objects that have been accessed since a last garbage collection process;

for each marked bundle within the bundle table, determining at least one marked card within the marked bundle table.

Agesen discloses requesting a list from a tracking mechanism, the list identifying a plurality of memory locations that have been accessed since the last ephemeral garbage collection (col. 15, line 67 – col. 16, line 7); *It should be noted that the "class remembered set" is analogous to the "list."*

creating a bundle table identifying a plurality of bundles (col. 9, lines 27-34; col. 17, lines 1-6); *It should be noted that the "scratch-pad list" is analogous to the "bundle table" and a "train" is analogous to a "bundle."*

updating bundles by marking two or more of the plurality of bundles in the table using the list, wherein the updated marked bundle corresponds to marked cards in the marked bundle having associated objects that have been accessed since a last garbage collection process (col. 9, lines 27-34; col. 17, lines 1-6); *See the citation note for the limitation directly above.*

for each marked bundle within the bundle table, determining at least one marked card within the marked bundle table (col. 18, lines 51-64).

Grarup and Agesen are analogous art because they are from the same field of endeavor, that being generational garbage collection systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to implement Agesen's garbage collector within Grarup's generational garbage collection process because all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by know

methods with no change in their respective functions, and the combination would have yielded the predictable results of enabling a garbage collection process to reclaim objects whose reclamation would otherwise impose unacceptable delays.

Therefore, it would have been obvious to combine Grarup and Agesen for the benefit of obtaining the invention as specified in claim 1.

7. **As per claim 2**, the combination of Grarup/Agesen discloses the tracking mechanism comprises a write-watch mechanism (Grarup, col. 9, lines 42-63; Agesen, col. 15, line 67 – col. 16, line 7).

8. **As per claim 3**, the combination of Grarup/Agesen discloses the write-watch mechanism operates within a memory manager (Grarup, col. 9, lines 42-63; col. 17, lines 34-41; Fig. 9, element 932; Agesen, col. 15, line 67 – col. 16, line 7). *It should be noted that the instructions within the computer program that manage the card marks operate within the processor, thus, the processor is analogous to the “memory manager.”*

9. **As per claim 4**, the combination of Grarup/Agesen discloses the write-watch mechanism records a first access to the memory location (Grarup, col. 9, lines 42-63; Agesen, col. 15, line 67 – col. 16, line 7).

10. **As per claim 5**, the combination of Grarup/Agesen discloses the list comprises a bitmap and each bit within the bitmap corresponds to one of the plurality of cards (Grarup, col. 9, lines 37-57).

11. **As per claim 6**, the combination of Grarup/Agesen discloses the list of memory locations is maintained in response to a request from the ephemeral garbage collection

process (Grarup, col. 10, line 65 – col. 11, line 1; Agesen, col. 15, line 67 – col. 16, line 7).

12. **As per claim 7**, the combination of Grarup/Agesen discloses resetting the list of memory locations (Grarup, col. 12, lines 62-66; Fig. 7a, element 707). *It should be noted that “clean” is analogous to “reset.”*

13. **As per claim 8**, the combination of Grarup/Agesen discloses the subset of cards corresponds to a number of cards that are tracked using a page of memory storing the card table (Grarup, col. 8, lines 64-67; col. 11, lines 18-25; Fig. 4b, elements 408, 420, and 452; Fig. 5, element 512).

14. **As per claim 9**, the combination of Grarup/Agesen discloses identifying the marked bundle comprises marking a bit associated with the marked bundle table within a bundle bitmap based on the memory locations within the list (Agesen, col. 9, lines 27-34; col. 17, lines 1-6). *It should be noted that having a per-train scratch-pad list requires marking a bit in a specific scratch-pad list’s bitmap which identifies its corresponding train.*

15. **As per claim 10**, the combination of Grarup/Agesen discloses marking the bit comprises setting the bit (Agesen, col. 9, lines 27-34; col. 17, lines 1-6).

16. **As per claim 11**, the combination of Grarup/Agesen discloses determining the at least one marked card comprises scanning a card bitmap having a bit for each of the plurality of cards, the bit for each marked card being different than another bit associated with one of the cards that was not accessed (Grarup, col. 12, lines 56-61; Fig. 7a, elements 703 and 704). *It should be noted that an accessed card has a “dirty”*

bit associated with it which is different than non-accessed card which has a "clean" bit associated with it.

17. **As per claim 12**, Grarup discloses a method for executing statements within a program to support ephemeral garbage collection, the method comprising:

specifying a range of card table memory to watch during program execution (col. 9, lines 25-32; Fig. 4b, elements 460 and 464) by calling a write-watch mechanism that performs tracking of the accesses to card table memory (col. 9, lines 42-63), the card table memory identifying a plurality of cards (col. 9, lines 19-25 and 37-41; Fig. 4b, elements 420, 450, and 452), each card being associated with one or more objects allocated within a memory heap (col. 7, lines 58-60; Fig. 4a, element 408), the memory heap being divided into a plurality of cards with each card being grouped into one of a plurality of bundles, (col. 8, lines 64-67; Fig. 4b, elements 408 and 420), wherein one of the plurality of bundles corresponds to a subset of that plurality of cards that are tracked using a page of card table memory (col. 8, lines 64-67; col. 11, lines 18-25; Fig. 4b, elements 408, 420, and 452; Fig. 5, element 512). *It should be noted that a "remembered set" specifies a range of card table memory to watch during program execution. It should also be noted that the "array of card marks" is analogous to the "card table memory."*

and for each store statement within the program, storing a value at a memory location within the heap memory based on the store statement (col. 11, lines 17-21; Fig. 5, element 504), marking one of the plurality of cards within the card table memory

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based on the memory location (col. 11, lines 21-25; Fig. 5, elements 512 and 514), and tracking access to the card table memory (col. 12, lines 51-54; Fig. 7a, element 702).

for each marked card, determining at least one accessed object within the marked card (col. 12, lines 51-54 and col. 12, line 66 – col. 13, line 1; Fig. 7a, elements 702 and 708); *It should be noted that "dirty" indicates "accessed."*

and performing garbage collection upon the at least one accessed object (col. 13, lines 1-4; Figs. 7b-7e).

Grarup does not disclose the write match mechanism maintains a write-watch list that identifies cards accessed within the card table memory since a garbage collection was last performed;

creating one or more bundle tables identifying groupings of the cards in the plurality of bundles;

updating at least one bundle table by marking the bundle table based on information obtained from the write-watch list, wherein the updated marked bundle table corresponds to marked cards having associated objects that have been accessed since a last garbage collection process;

for each marked bundle table, determining at least one marked card within the marked bundle table.

Agesen discloses the write match mechanism maintains a write-watch list that identifies cards accessed within the card table memory since a garbage collection was last performed (col. 15, line 67 – col. 16, line 7); *It should be noted that the "class remembered set" is analogous to the "write-watch list."*

creating one or more bundle tables identifying groupings of the cards in the plurality of bundles (col. 9, lines 27-34; col. 17, lines 1-6); *It should be noted that the "scratch-pad list" is analogous to the "bundle table" and a "train" is analogous to a "bundle."*

updating at least one bundle table by marking the bundle table based on information obtained from the write-watch list, wherein the updated marked bundle table corresponds to marked cards having associated objects that have been accessed since a last garbage collection process (col. 9, lines 27-34; col. 17, lines 1-6); *See the citation note for the limitation directly above.*

for each marked bundle table, determining at least one marked card within the marked bundle table (col. 18, lines 51-64).

Grarup and Agesen are analogous art because they are from the same field of endeavor, that being generational garbage collection systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to implement Agesen's garbage collector within Grarup's generational garbage collection process because all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded the predictable results of enabling a garbage collection process to reclaim objects whose reclamation would otherwise impose unacceptable delays.

Therefore, it would have been obvious to combine Grarup and Agesen for the benefit of obtaining the invention as specified in claim 12.

18. **As per claim 14**, the combination of Grarup/Agesen discloses the write-watch mechanism resides within a memory manager and sets bits in the card table upon access to at least one of the plurality of cards (Grarup, col. 9, lines 42-63; col. 17, lines 34-41; Fig. 9, element 932; Agesen, col. 15, line 67 – col. 16, line 7). *It should be noted that the instructions within the computer program that manage the card marks operate within the processor, thus, the processor is analogous to the “memory manager.”*

19. **As per claim 17**, the combination of Grarup/Agesen discloses an ephemeral garbage collection process requests the list when performing a garbage collection cycle (Grarup, col. 10, line 65 – col. 11, line 1; Agesen, col. 18, lines 51-64). *It should be noted that “evacuation” is part of the “garbage collection cycle.”*

20. **As per claim 18**, the combination of Grarup/Agesen discloses the ephemeral garbage collection process determines a marked bundle based on the write-watch list (Agesen, col. 9, lines 27-34; col. 17, lines 1-6).

21. **As per claim 19**, Grarup discloses a system for performing ephemeral garbage collection, the system comprising:

a processor (col. 17, lines 36-38; Fig. 9, element 932);

and a memory into which a plurality of instructions are loaded and into which a plurality of objects are dynamically allocated (col. 17, lines 43-45; Fig. 9, element 934), the memory having a heap into which the objects are allocated (col. 1, lines 61-63; Fig. 1, elements 10 and 20), the heap being divided into a plurality of cards which are grouped into a plurality of bundles (col. 8, lines 64-67; Fig. 4b, elements 408 and 420), each card being associated with one or more of the plurality of objects (col. 7, lines 58-

60; Fig. 4a, element 408); wherein upon execution of the plurality of instructions by the processor, the system being configured to:

each memory location corresponding to one of a the plurality of cards associated with a card table, wherein the card table identifies one or more cards that have been accessed (col. 9, lines 19-25 and 37-57; Fig. 4b, element 450), *See the citation note for similar limitation in claim 1 above.*

determine, for each marked card, the one or more objects that has been accessed (col. 12, lines 51-54 and col. 12, line 66 – col. 13, line 1; Fig. 7a, elements 702 and 708). *See the citation note for similar limitation in claim 1 above.*

and perform garbage collection upon the one or more accessed objects (col. 13, lines 1-4; Figs. 7b-7e).

Grarup does not disclose requesting a list from a tracking mechanism, the list only identifying a plurality of memory locations that have been written to since the last garbage collection cycle;

creating one or more bundle tables wherein each bundle table identifies groupings of the plurality of cards in the plurality of bundles;

updating at least one bundle table by marking bundles within the bundle table based on the list, wherein the marked bundles corresponds to marked cards having associated objects that have been accessed since a last garbage collection process;

determining, for each marked bundle, at least one marked card within the marked bundle, the at least one marked card indicating that one or more objects associated with the marked card have been accessed.

Agesen discloses requesting a list from a tracking mechanism, the list only identifying a plurality of memory locations that have been written to since the last garbage collection cycle (col. 15, line 67 – col. 16, line 7); *See the citation note for the similar limitation in claim 1 above.*

creating one or more bundle tables wherein each bundle table identifies groupings of the plurality of cards in the plurality of bundles (col. 9, lines 27-34; col. 17, lines 1-6); *See the citation note for the similar limitation in claim 1 above.*

updating at least one bundle table by marking bundles within the bundle table based on the list, wherein the marked bundles corresponds to marked cards having associated objects that have been accessed since a last garbage collection process (col. 9, lines 27-34; col. 17, lines 1-6); *See the citation note for the similar limitation in claim 1 above.*

determining, for each marked bundle, at least one marked card within the marked bundle, the at least one marked card indicating that one or more objects associated with the marked card have been accessed (col. 18, lines 51-64).

Grarup and Agesen are analogous art because they are from the same field of endeavor, that being generational garbage collection systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to implement Agesen's garbage collector within Grarup's generational garbage collection process because all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have

yielded the predictable results of enabling a garbage collection process to reclaim objects whose reclamation would otherwise impose unacceptable delays.

Therefore, it would have been obvious to combine Grarup and Agesen for the benefit of obtaining the invention as specified in claim 19.

22. **As per claim 20**, the combination of Grarup/Agesen discloses the tracking mechanism comprises a write-watch mechanism (Grarup, col. 9, lines 42-63; Agesen, col. 15, line 67 – col. 16, line 7).

23. **As per claim 21**, the combination of Grarup/Agesen discloses the write-watch mechanism operates within a memory manager and sets bits in the card table upon access to at least one of the plurality of cards (Grarup, col. 9, lines 42-63; col. 17, lines 34-41; Fig. 9, element 932; Agesen, col. 15, line 67 – col. 16, line 7). *See the citation note for claim 14 above.*

24. **As per claim 22**, the combination of Grarup/Agesen discloses the subset of cards corresponds to a number of cards that are tracked using a page of memory storing the card table (Grarup, col. 8, lines 64-67; col. 11, lines 18-25; Fig. 4b, elements 408, 420, and 452; Fig. 5, element 512).

25. **As per claim 23**, the combination of Grarup/Agesen discloses the marked bundle being identified by a marked bit associated with the marked bundle within a bundle bitmap based on the list (Agesen, col. 9, lines 27-34; col. 17, lines 1-6). *See the citation note for claim 9 above.*

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26. **As per claim 24**, the combination of Grarup/Agesen discloses setting a bit in the card table to identify one or more cards that have been accessed (Grarup, col. 9, lines 42-63; col. 11, lines 18-25; Fig. 4b, elements 450 and 452; Fig. 5, Element 514).

Response to Arguments

27. Applicant's arguments with respect to **claims 1-12, 14, and 17-24** have been considered but are moot in view of the new grounds of rejection above.

Conclusion

STATUS OF CLAIMS IN THE APPLICATION

The following is a summary of the treatment and status of all claims in the application as recommended by MPEP 707.70(i):

CLAIMS REJECTED IN THE APPLICATION

Per the instant office action, **claims 1-12, 14, and 17-24** have received a second action on the merits and are subject of a second action non-final.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arpan P. Savla whose telephone number is (571)272-1077. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sanjiv Shah can be reached on (571) 272-4098. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Arpan Savla/
Examiner, Art Unit 2185
April 14, 2008

/Sanjiv Shah/
Supervisory Patent Examiner, Art Unit 2185